

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
10 May 2001 (10.05.2001)

PCT

(10) International Publication Number  
**WO 01/32394 A1**

(51) International Patent Classification<sup>7</sup>: **B29C 47/00,**  
55/02

[IT/IT]: Strada Romana, 44, I-46030 Cerese di Virgilio  
(IT). **BORTOLETTO, Graziano** [IT/IT]; Via Pietro  
Micca, 5, I-31059 Zero Branco (IT).

(21) International Application Number: PCT/IB00/01572

(22) International Filing Date: 31 October 2000 (31.10.2000)

(74) Agent: **PREMRU, Rok**; Via De Amicis, 4, I-20052  
Monza (IT).

(25) Filing Language: Italian

(81) Designated State (*national*): US.

(26) Publication Language: English

(84) Designated States (*regional*): European patent (AT, BE,  
CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC,  
NL, PT, SE).

(30) Priority Data:  
MI99A002318 5 November 1999 (05.11.1999) IT

**Published:**

- With international search report.
- With amended claims and statement.

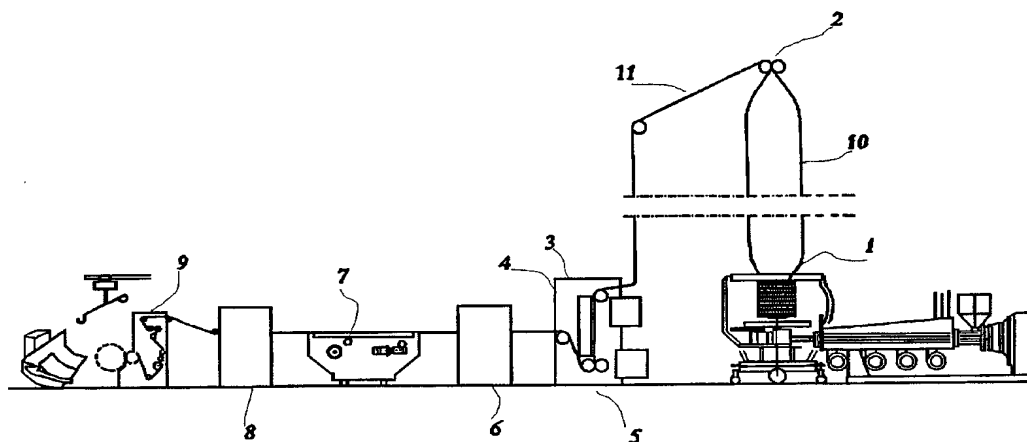
(71) Applicant (*for all designated States except US*): **NUOVA  
PANSAC S.P.A.** [IT/IT]; Viale Francesco Restelli, 5,  
I-20124 Milano (IT).

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **LORI, Fabrizio**

(54) Title: APPARATUS AND METHOD FOR PRODUCING A POLYOLEFINIC TRANSPIRING FILM



(57) Abstract: The invention relates to a method and a plant for producing polyolefinic transpiring films by means of bubble extrusion of a charged LLDPE mix, flattening of the extruded tubular in order to obtain a flat film and transversal and/or longitudinal stretching of the flat film.



WO 01/32394 A1

## APPARATUS AND METHOD FOR PRODUCING A POLYOLEFINIC TRANSPIRING FILM

\*\*\*\*\*

The present invention relates to an apparatus and method for producing a polyolefinic transpiring film, capable of allowing vapour and air to pass therethrough while being impermeable to liquids.

The patent EP 0.283.200 B1, to which reference is made for a general view of the prior art, describes a method for producing transpiring films in which a linear polyethylene extrusion at low density (LLDPE), charged with  $\text{CaCO}_3$ , is first heat-embossed, for providing reduced thickness imprints, and then stretched to obtain a transpiring film with a particularly elevated transpirability in the reduced thickness zones.

Transpiring films according to the prior art moreover have various problems and drawbacks. One problem which is encountered in known polyolefinic transpiring films is the possible formation of micro-holes during the stretching phase of the film, which formation is due to the presence of impurities, in particular oxidised and carbonised particles.

Such impurities may already be present in the mix to be extruded, or they may form during the extrusion process of the polyethylene.

The micro-holes, which have an average diameter between 0.2 and 2 mm, may compromise the liquid impermeability characteristics; such risk increases with the speed of the stretching process and with the increase in the degree of stretching of the film.

Another problem which is encountered in polyolefinic transpiring films is the non-uniformity of the transpirability.

A principle aim of the present invention is to provide a method and an apparatus for producing a polyolefinic transpiring film which allow to overcome at least part of the above cited problems. Such aim is obtained by means of a method in accordance with the claim 1 and by means of a plant in accordance with claim 4.

Further embodiments of the method may be carried out in accordance with the dependent claims 2 and 3, and further embodiments of the plant may be carried out in accordance with the dependent claims 5 and 6.

The method and the apparatus according to the invention will appear in a clear manner from the following description of one possible embodiment, provided in a purely indicative manner, together with the drawing figure which shows, in a schematic view, a manufacturing plant in accordance with the invention.

The present method provides for the use of a mix preferably of linear polyethylene at low density (LLDPE) charged with a base of  $\text{CaCO}_3$ .

Alternatively, it is possible to use linear polyethylene at low density (LLDPE) or polyethylene at medium density (MDPE).

It is also possible to use copolymers of polyethylene having  $\alpha$ -olefin with 4-10 atoms of carbon (1 butene, 1 pentene, 1 esene, 1 eptene, 1 ottene, 4 metil, 1 pentene).

Naturally, it is also possible to use other types of charges, organic or inorganic, having dimensions between 0.6 and 6  $\mu\text{m}$  and treated in a way to render their surfaces hydrophobic.

In particular, it is possible to use: clay, kaolin, zeolite, Zn, Al, Ca,  $\text{CaSO}_4$ ,  $\text{BaSO}_4$ , MgO,  $\text{Mg(OH)}_2$ ,  $\text{TiO}_2$ .

The quality of the added charge depends also on the degree of desired traspirability, normally the charge constitutes from 30% to 70% by weight of the mix.

Such mix is bubble-extruded (so-called blow moulding), by means of a circular-head extruder 1 in order to obtain a tubular 10.

The temperature of the tubular exiting from the extruder 1 is between 150-230°C and, preferably, between 170-190°C.

The ratio of expansion of the tubular 10 may vary between 1:2 and 1:4, and preferably is 1:3.

One characteristic of the method of the present invention is the fact that the extruded and expanded tubular 10 is subjected to a calendering operation.

In detail, the tubular 10 enters, at a temperature of about 80-100°C, in a first calender 2 where it is compressed and stretched into the form of a sheet 11, constituted by two superimposed layers, assuming a width equal to half of the circumference of the tubular and a thickness which is double with respect to the thickness of the tubular.

Such characteristic has the advantage of resolving the problem of insufficient liquid impermeability due to the micro-holes which may form in the films during the stretching phase: it is in fact extremely improbable that both the layers of the film are damaged at the same point. The calender 2 used for flattening the tubular 10 comprises a pair of smooth coupled rollers of which the first one is chromed steel and the second one is rubber with a hardness of 60-80 shore; the pressure supplied by the calender 2 on the flattened tubular 10 varies between 5 and 10 kg/cm<sup>2</sup>.

A second characteristic of the method according to the invention consists in the fact that after having been flattened, the film 11 is heated up to a softening temperature.

Such temperature depends on the type of mix which is extruded, in the case of an LLDPE base mix it may vary between 80 and 130 °C and usually, it is around about 100 °C.

The heating executed in this manner favours the removal of humidity or of additives present in the mix which have a low evaporation point.

Moreover, the heating executed in this manner favours the elimination of micro-stresses present in the film due to the preceding phases of the method and favours the homogenisation of the internal structure of the film.

In order to obtain the heating, the film 11 is first made to run on heated rollers 3, having a temperature of about 60-70 °C, and then made to pass near infrared ray lamps 4 which further increase the temperature up to the point of softening.

In fact the use only of the heated rollers - normally heated with water or oil - does not allow to reach the softening temperature, or at least with great difficulty.

Moreover, the infrared lamps provide the advantage of also strongly heating the layer of air about the film 11 (typically up to 300-400 °C) which therefore permits to completely eliminate the residual humidity still present on the film 11.

A third characteristic of the method according to the invention consists in the fact that the film heated in this manner is further calandered by a calender 5 and, thereafter, cooled to a temperature between 8 and 30 °C.

Such cooling is carried out, preferably, through contact by means of one of the rollers of the calander 5, which is maintained at a constant temperature between 8 and 30 °C.

The further calendering permits, through the compression provided by the rollers, to intimately unite the two original layers so as to avoid the risks of de-lamination of the film produced in this manner, and the thermal shock to which the film is subjected permits to block the stabilisation process.

It is also possible, in this phase, to carry out an embossing operation of the film for a purely aesthetic purpose which does not modify the weight of the film.

It has been found that the thermal shock to which the film is subjected allows to obtain an improved transpirability during the successive stretching operations.

The compression of the film is obtained by coupling a chromed-steel roller coupled with a rubber roller (hardness 60-80 shore).

Successively to the process of sterilisation, the film 11 is subjected to transverse and/or longitudinal stretching.

For such purpose, there are present appropriate means 6 adapted to carry out the transversal stretching and appropriate means 8 adapted to carry out the longitudinal stretching.

In the illustrated example, the film 11 is subjected first to a transversal stretching and then to a longitudinal stretching: naturally these phases may also be inverted.

Preferably between the transversal stretching means 6 and the longitudinal stretching means 8 there are provided tentering means 7 for eliminating the folds created by the first process of stretching.

Normally, the ratio of longitudinal stretching varies between 1:1.5 and 1:2.5.

Also in this manner, the ratio of longitudinal stretching varies, usually, between 1:1.5 and 1:2.5.

However, if required, the ratio of stretching may also arrive to a ratio of 1:4.

At the end of the stretching phase, the film 11 may undergo further working steps or be wound up by an appropriate winding machine 9.

## CLAIMS

1. Method for producing polyolefinic transpiring films comprising the steps of:

bubble extruding a mix of charged LLDPE:

flattening the tubular (10) in order to obtain a flat film (11);

transversal and/or longitudinal stretching of the flat film (11).

2. Method, according to claim 1, wherein, before the stretching step, there are provided the further steps of:

heating the flat film (11) up to a softening temperature;

compressing the flat film (11);

cooling the flat film to a temperature between 8-30 °C.

3. Method, according to claim 2, wherein the flat film (11) is first heated by conduction and successively by irradiation.

4. Plant for producing a stretched polyolefinic film comprising, in succession:

a bubble extruder (1);

a first calender (2) adapted to flatten the extruded tubular;

means (6) adapted to transversally stretch the film and/or means (8) adapted to longitudinally stretch the film.

5. Plant, according to claim 4, further comprising, before the transversal (6) and/or the longitudinal (8) stretching means, in succession:

means (3,4) adapted to heat the flat film (11) up to a softening temperature;

a second calender (5) adapted to compress the heated film;

means (5) adapted to quickly cool the film up to a temperature comprised between 8-30 °C.

6. Plant, according to claim 4 or 5, wherein said means adapted to heat the flat film (11) comprise, in succession:

first heating means, adapted to heat the film by conduction; and

second heating means adapted to heat the film by irradiation.



**AMENDED CLAIMS**

[received by the International Bureau on 7 March 2001 (07.03.01);  
original claims 1-6 replaced by new claims 1-4 (1 page)]

1. Method for producing polyolefinic transpiring films comprising the steps of:

- bubble extruding a mix of charged LLDPE;
- flattening the tubular (10) in order to obtain a flat film (11);
- heating the flat film (11) up to a softening temperature;
- compressing the flat film (11);
- cooling the flat film to a temperature between 8-30 °C; and
- transversal and/or longitudinal stretching of the flat film (11).

2. Method, according to claim 1, wherein the flat film (11) is first heated by conduction and successively by irradiation.

3. Plant for producing a stretched polyolefinic film comprising, in succession:

- a bubble extruder (1);
- a first calender (2) adapted to flatten the extruded tubular;
- means (3,4) adapted to heat the flat film (11) up to a softening temperature;
- a second calender (5) adapted to compress the heated film;
- means (5) adapted to quickly cool the film up to a temperature comprised between 8-30 °C;
- means (6) adapted to transversally stretch the film and/or means (8) adapted to longitudinally stretch the film.

4. Plant, according to claim 3, wherein said means adapted to heat the flat film (11) comprise, in succession:

first heating means, adapted to heat the film by conduction; and  
second heating means adapted to heat the film by irradiation.

**Statement under Article 19(1)**

New claim 1 comprises the subject matter of original claim 1 and original claim 2.

New claim 2 corresponds to original claim 3.

New claim 3 comprises the subject matter of original claim 4 and original claim 5.

New claim 4 corresponds to original claim 6.

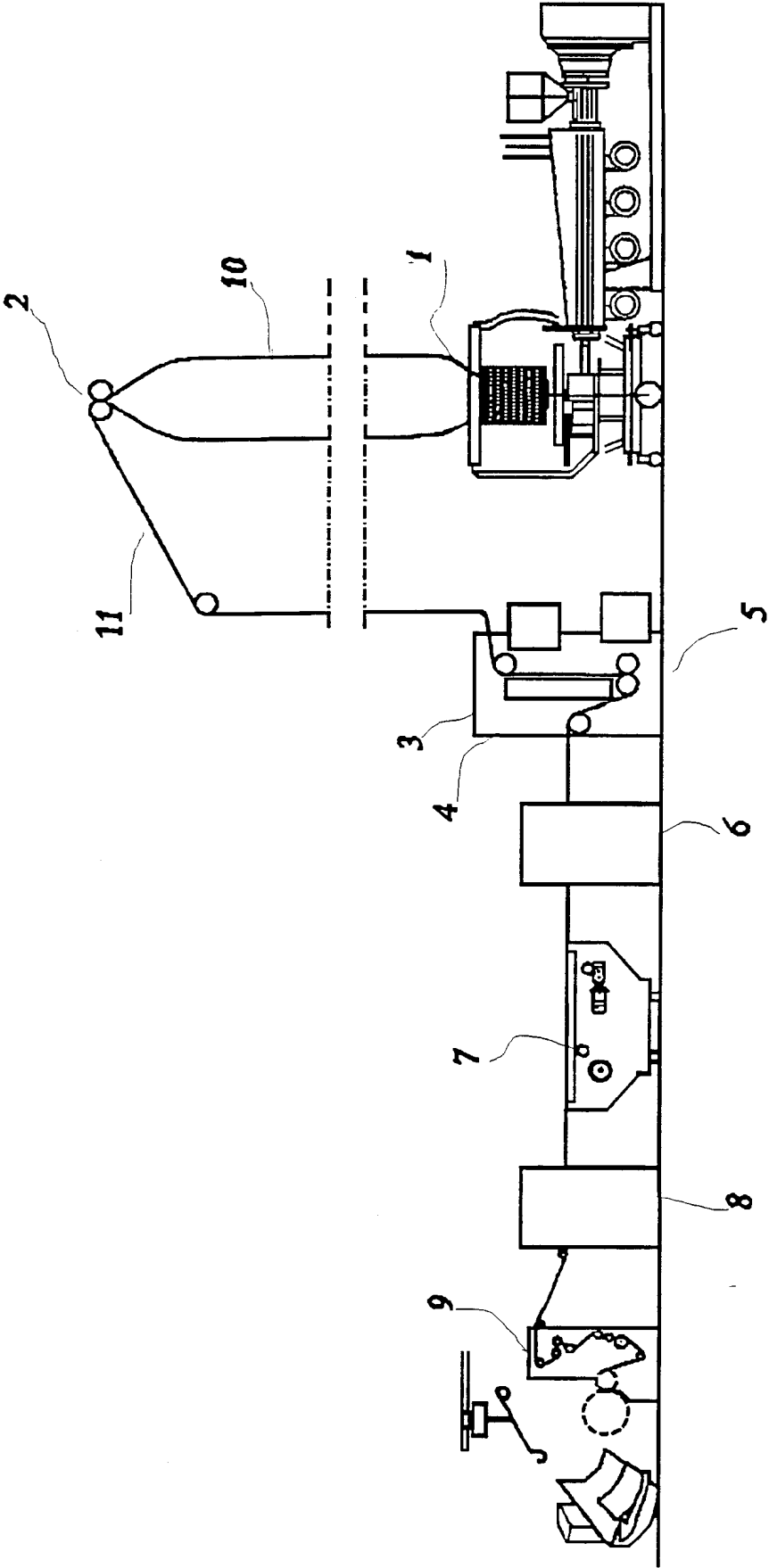


Fig. 1

# INTERNATIONAL SEARCH REPORT

Int. Application No.  
PCT/IB 00/01572

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 B29C47/00 B29C55/02

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 363 937 A (KAO CORP) 18 April 1990 (1990-04-18) embodiment 2; page 5, line 32 - line 44; figure 1; tables 1,3	1, 4, 6
X	EP 0 283 200 A (EXXON CHEMICAL PATENTS INC) 21 September 1988 (1988-09-21) cited in the application page 3, line 19 - line 23 page 3, line 45 - line 46 page 3, line 57 - page 4, line 1 page 4, line 7 - line 9 page 4, line 28 - line 33 --- -/--	1

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*G\* document member of the same patent family

Date of the actual completion of the international search

6 February 2001

Date of mailing of the international search report

21/02/2001

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Attalla, G

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 00/01572

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 277 594 A (MATTHEWS STEPHEN B ET AL) 7 July 1981 (1981-07-07) column 5, line 43 - line 46 column 5, line 49 - line 52 column 5, line 55 - column 6, line 2 ---	4, 6
A	US 5 232 767 A (HISAZUMI NOBUYUKI ET AL) 3 August 1993 (1993-08-03) column 14, line 29 - line 33 ---	
A	GB 1 116 739 A (SHELL INTERNATIONAL) 12 June 1968 (1968-06-12) page 2, line 118 - line 121 ---	6
A	US 5 110 686 A (TAKA TOSHIO ET AL) 5 May 1992 (1992-05-05) column 5, line 1 - line 32 ---	4-6
A	US 3 884 748 A (STANGL GEORG ET AL) 20 May 1975 (1975-05-20) column 3, line 13 - line 19 ---	4-6
A	AT 311 666 B (CHEMIEFASER LENZING AG) 15 October 1973 (1973-10-15) page 3, line 1 - line 6 -----	4-6

# INTERNATIONAL SEARCH REPORT

Information on patent family members

Int. :ional Application No

PCT/IB 00/01572

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0363937 A	18-04-1990	JP 2103121 A JP 2571612 B US 5068070 A	16-04-1990 16-01-1997 26-11-1991
EP 0283200 A	21-09-1988	US 4777073 A AT 109721 T AU 609095 B AU 1287188 A CA 1322082 A DE 3850987 D DE 3850987 T JP 63276529 A US 4929303 A US 5055338 A	11-10-1988 15-08-1994 26-04-1991 15-09-1988 14-09-1993 15-09-1994 15-12-1994 14-11-1988 29-05-1990 08-10-1991
US 4277594 A	07-07-1981	NONE	
US 5232767 A	03-08-1993	JP 3030947 A AU 616121 B AU 5787690 A DE 69009309 D DE 69009309 T EP 0405933 A ES 2054252 T	08-02-1991 17-10-1991 03-01-1991 07-07-1994 08-09-1994 02-01-1991 01-08-1994
GB 1116739 A		NL 6513127 A NL 6605050 A NL 6605051 A AT 294414 B BE 688021 A DE 1629656 A SE 312670 B	12-04-1967 16-10-1967 16-10-1967 15-10-1971 10-04-1967 04-02-1971 21-07-1969
US 5110686 A	05-05-1992	WO 8603452 A CA 1291311 A DE 3483427 D EP 0204843 A US 4913977 A US 5294398 A	19-06-1986 29-10-1991 22-11-1990 17-12-1986 03-04-1990 15-03-1994
US 3884748 A	20-05-1975	DE 2158141 A AT 343349 B AT 993472 A BE 791861 A CA 1004012 A CH 547162 A ES 408745 A FR 2161059 A GB 1368914 A IT 1030528 B JP 48060169 A JP 57060130 B NL 7215586 A	30-05-1973 26-05-1978 15-09-1977 24-05-1973 25-01-1977 29-03-1974 16-05-1976 06-07-1973 02-10-1974 10-04-1979 23-08-1973 17-12-1982 28-05-1973
AT 311666 B	15-10-1973	NONE	